

Appl. No. 10/024,838
Amtd. dated November 23, 2004
Reply to Office Action of August 24, 2004

Amendments to the Claims:

The listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (currently amended): An apparatus for rapid heat-cure of sol-gel coatings adhered to a substrate, the apparatus comprising:

a supporting structure;

an IR heating source mounted on the supporting structure and configured to generate emit IR radiation in a predetermined heating pattern; and

a transfer assembly configured to sequentially expose discrete segments of the coated substrate to the heating-pattern IR radiation at a selected distance and for a selected duration, such that the heat energy from the IR radiation sufficiently cures or densifies the sol-gel coating, but does not unduly heat the substrate to cause deformation.

Claim 2 (original): An apparatus as defined in claim 1, wherein the transfer assembly is configured to transport the coated substrate past the heating source and the substrate is transported at a speed in the range of about 0.5 to about 50 centimeters per second.

Claim 3 (canceled)

Claim 4 (currently amended): An apparatus as defined in claim ~~[[3]]~~1, wherein the IR source emits IR radiation at a power level in the range of about 40 to about 80 watts per centimeter.

Claims 5-8 (canceled)

Claim 9 (currently amended): An apparatus as defined in claim 1, ~~wherein the heating source includes~~

~~— an IR source mounted on the supporting structure and configured to emit IR radiation in a predetermined pattern, and~~

~~— and further comprising a gas nozzle mounted on the supporting structure in spaced~~

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relationship from the IR heating source, connectable to a heated gas source, and configured to expel a heated gas stream in a predetermined pattern.

Claim 10 (currently amended): An apparatus as defined in claim 9, wherein the transfer assembly is configured to transport the coated substrate past the IR heating source and the gas nozzle and the substrate is transported at a speed in the range of about 0.5 to about 50 centimeters per second.

Claim 11 (currently amended): An apparatus as defined in claim 9, wherein the IR heating source emits IR radiation at a power level in the range of about 40 to about 80 watts per centimeter.

Claim 12 (currently amended): An apparatus as defined in claim 9, wherein the IR heating source is two IR lamps in opposed relation to each other such that the coated substrate can pass therebetween at a selected distance from both.

Claim 13 (original): An apparatus as defined in claim 9, further including a second gas nozzle in opposed relation to the first gas nozzle such that the coated substrate can pass therebetween at a selected distance from both.

Claim 14 (original): An apparatus as defined in claim 9, wherein the substrate is a plastic material having a low melting point, wherein the plastic material is selected from the group consisting of polymethyl methacrylate, polycarbonate, polyester, and CR-39.

Claim 15 (original): An apparatus as defined in claim 9, further including a heated gas source connected to the gas nozzle.

Claim 16 (original): An apparatus as defined in claim 15, wherein the gas is selected from the group consisting of air, nitrogen, argon, helium, and combinations thereof.

Claim 17 (original): An apparatus as defined in claim 15, wherein the heated gas source is configured to allow injecting steam, or other water forms, into the heated gas stream.

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Claim 18 (original): An apparatus as defined in claim 15, wherein the temperature of the heated gas stream is in the range of about 100 to about 500° C and the flow rate of the heated gas stream is in the range of about 50 to about 10,000 cubic centimeters per second.

Claim 19 (currently amended): A process for rapidly heat-curing a sol-gel coating adhered to a substrate, comprising sequentially exposing discrete segments of the coated substrate to an IR heating source at a selected distance and at a selected rate, wherein the IR heating source emits IR radiation in a predetermined pattern, and wherein the heat energy from the IR heating source sufficiently cures or densifies the sol-gel coating to its optimum physical and optical properties, but does not unduly heat the substrate to cause deformation.

Claim 20 (original): A product produced by the process of claim 19.

Claim 21 (currently amended): A process as defined in claim 19, wherein the coated substrate is transported past the IR heating source and the substrate is transported at a speed in the range of about 0.5 to about 50 centimeters per second.

Claim 22 (canceled)

Claim 23 (currently amended): A process as defined in claim 19, wherein the IR heating source emits IR radiation at a power level in the range of about 40 to about 80 watts per centimeter.

Claim 24 (currently amended): A process as defined in claim 19, ~~wherein the heating source is~~ and further comprising a gas nozzle connectable to a heated gas source, and configured to expel a heated gas stream in a predetermined pattern.

Claims 25-28 (canceled)

Claim 29 (currently amended): A product produced by the process of claim ~~[[28]]~~24.

Claim 30 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the process is repeated to produce a product having multiple layers of sol-gel coatings.

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Claim 31 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the substrate is a plastic material having a low melting point, wherein the plastic material is selected from the group consisting of polymethyl methacrylate, polycarbonate, polyester, and CR-39.

Claim 32 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the heated gas is selected from the group consisting of air, nitrogen, argon, helium, and combinations thereof.

Claim 33 (currently amended): A process as defined in claim ~~[[28]]~~24, and further comprising introducing moisture into the curing process by injecting steam, or other water forms, into the heated gas stream.

Claim 34 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the temperature of the heated gas stream is in the range of about 100 to about 500° C and the flow rate of the heated gas stream is in the range of about 50 to about 10,000 cubic centimeters per second.

Claim 35 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the substrate is sequentially exposed to the IR radiation from the IR heating source and the heated gas stream at a speed in the range of about 0.5 to about 50 centimeters per second.

Claim 36 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the IR heating source emits IR radiation at a power level in the range of about 40 to about 80 watts per centimeter.

Claim 37 (currently amended): A process as defined in claim ~~[[28]]~~24, wherein the sol-gel coating forms an optical coating and/or an abrasion coating.

Claim 38 (original): A process as defined in claim 37, wherein the optical coating is a multi-layer optical stack that produces an antireflection coating.